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when all the sections of m will have been passed up, and the trains may proceed.

Variously solved by *P. S. BERG, C. W. M. BLACK, H. W. DROUGHON, H. C. WHITAKER,* and *G. B. M. ZERR.*

PROBLEMS.

23. **Proposed by ROBERT J. ALEY, A. M., Professor of Mathematics in Indiania University, Bloomington, Indiana.**

Sum to n terms the following series: $11+25+45+71+103+\ldots.$

24. **Proposed by ARTEMAS MARTIN, LL. D., U. S. Coast and Geodetic Survey Office, Washington, D. C.**

Find x and y from the equations,

$$x^2+2xy^2-2xy=4y^3,$$
$$y^4+2x^3y^2-2xy^2=4x^4.$$

25. **Proposed by P. C. CULLEN, Meade, Nebraska.**

A man and a boy get n dollars for digging potatoes, the man can dig them as fast as the boy can pull the vines, but the man can pull vines m times as fast as the boy can dig them. Divide the money.

Solutions to these problems should be received on or before August 1st.

GEOMETRY.

Conducted by B.F.FINKEL,Kidder, Missouri. All Contributions to this department should be sent to him.

SOLUTIONS TO PROBLEMS.

11. **Proposed by MISS LEOTA MILLER, B. L., Professor of Natural Science and Art, Kidder Institute, Kidder, Missouri.**

A gentleman's residence is at the centre of his circular farm containing $a=900$ acres. He gives to each of his $m=7$ children an equal circular farm as large as can be made within the original farm; and he retains as large a circular farm of which his residence is the centre, as can be made after the distribution. Required the area of the farms made.

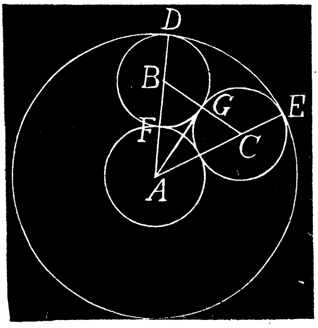
Solution by Professor P. H. PHILBRICK, C. E., Lake Charles, Louisiana; and Professor G. B. M. ZERR, A. M., Principal of High School, Staunton, Virginia.

Let A be the centre of the farm, B, C, the centres of two of the m farms for the children. Let $BG=GC=x$.

Then $AB=r-x$ where r is the radius of the whole farm. $AF=r-2x$.

Then $BG:AB=\sin BAG:1$,

$$\therefore\quad x=(r-x)\sin\frac{\pi}{m}.\quad \therefore\ x=\frac{r\sin\frac{\pi}{m}}{1+\sin\frac{\pi}{m}}.$$



$$r-2x=\frac{r\left(1-\sin\frac{\pi}{m}\right)}{1+\sin\frac{\pi}{m}};\ \pi x^2=\pi r^2\left\{\frac{\sin\frac{\pi}{m}}{1+\sin\frac{\pi}{m}}\right\}^2=\frac{a\left(\sin\frac{\pi}{m}\right)^2}{\left(1+\sin\frac{\pi}{m}\right)^2}.$$

$$\pi(r-2x)^2=\frac{a\left(1-\sin\frac{\pi}{m}\right)^2}{\left(1+\sin\frac{\pi}{m}\right)^2}=$$

area of each child's farm $=a\left\{\frac{\sin\frac{\pi}{m}}{1+\sin\frac{\pi}{m}}\right\}^2=900\left(\frac{\sin\frac{\pi}{7}}{1+\sin\frac{\pi}{7}}\right)^2=82.4049+$acres.

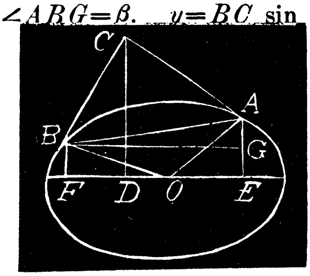
Area of father's farm $=a\left(\frac{1-\sin\frac{\pi}{m}}{1+\sin\frac{\pi}{m}}\right)^2=9\left(\frac{1-\sin\frac{\pi}{7}}{1+\sin\frac{\pi}{7}}\right)^2=140.292-$acres.

Excellent solutions were received from *P. S. BERG, J A. CALDERHEAD, LEONARD E, DICKSON, H. C. WHITAKER, J. F. W. SCHEFFER, SETH PRATT, A. H. BELL*, and *J. R. BALDWIN*.

12. Proposed by Professor J. F. W. SCHEFFER, A. M. Hagerstown, Maryland.

Let OA and OB represent two variable conjugate semi-diameters of the ellipse $\frac{y^2}{a^2}+\frac{y^2}{b^2}=1$. On the chord AB as a side described an equilateral triangle ABC. Find the locus of C.

Solution by the PROPOSER.



$OD=x$, $CD=y$, $\angle BOF=\phi$, $\angle AOE=\lambda$, $\angle ABG=\beta$. $y=BC\sin(60^\circ+\beta)+OB\sin\phi=AB\sin(60^\circ+\beta)+OB\sin\phi=AB(\frac{1}{2}\surd3\cos\beta+\frac{1}{2}\sin\beta)+OB\sin\phi\ldots.(1)$.

$x=OB\cos\phi-BC\sin(60^\circ+\beta)=OB\cos\phi-AB\cos(60^\circ+\beta)=OB\cos\phi-AB(\frac{1}{2}\cos\beta-\frac{1}{2}\surd3\sin\beta)\ldots.(2)$. But $AB\sin\beta=AE-BF=AO\sin\lambda-OB\sin\phi$, $AB\cos\beta=OE+OF=AO\cos\lambda+OB\cos\phi$.

Substituting these in (1) and (2), we have $y=\frac{1}{2}AO(\surd3\cos\lambda+\sin\lambda)+\frac{1}{2}OB(\surd3\cos\phi+\sin\phi)..(3)$.

$x=\frac{1}{2}AO(\surd3\sin\lambda-\cos\lambda)+\frac{1}{2}OB(\cos\phi-\surd3\sin\phi)\ldots.(4)$.

But by the well-known relation of conjugate diameters,

$$AO^2=\frac{a^2b^2}{a^2\sin^2\lambda+b^2\cos^2\lambda}=\frac{a^4\sin^2\phi+b^4\cos^2\phi}{a^2\sin^2\phi+b^2\cos^2\phi},\text{ for }\tan\phi\tan\lambda=\frac{b^2}{a^2},$$

$$BO^2=\frac{a^2b^2}{a^2\sin^2\phi+b^2\cos^2\phi},\ \sin\lambda=\frac{b^2\cos\phi}{(a^4\sin^2\phi+b^4\cos^2\phi)^{\frac{1}{2}}},$$

$$\cos\lambda=\frac{a^2\sin\phi}{(a^4\sin^2\phi+b^4\cos^2\phi)^{\frac{1}{2}}}.$$

Substituting in (3) and (4) we obtain after some easy reductions: